

AD-A054 996

ARMY INST OF DENTAL RESEARCH WASHINGTON D C
HEALING OF THE ORAL MUCOSA WITH THE USE OF COLLAGEN ARTIFICIAL --ETC(U)
MAR 78 M P LEVIN, P J TSAKNIS, D E CUTRIGHT

F/G 6/16

UNCLASSIFIED

NL

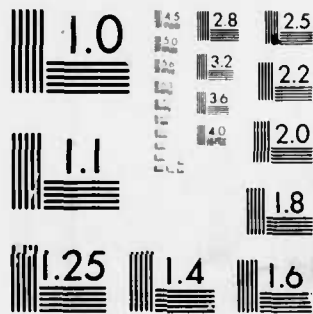
| OF |

AD
A054 996



END
DATE
FILMED
7-78

DDC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FOR FURTHER TRAN

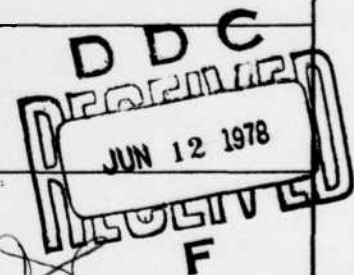
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

AD A 054996

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 6	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER 9 Rept. for
4. TITLE (and Subtitle) Healing of the Oral Mucosa with the Use of Collagen Artificial Skin		5. TYPE OF REPORT & PERIOD COVERED Manuscript 10 Nov 1975 - 15 Feb 1977
6. AUTHOR(s) Marvin P. Levin, Peter J. Tsaknis, Duane E. Cutright		7. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Institute of Dental Research Walter Reed Army Medical Center Washington, D.C. 20012		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Medical Research & Development Command HQDA (SGRD-PL) WASH DC 20314		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 12 19p.		12. REPORT DATE 30 Mar 1978
		13. NUMBER OF PAGES 19
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) This document has been approved for public release and sale; its distribution is unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES None		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) healing, collagen, artificial skin, oral mucosa, biomaterials, wound dressing, gingival dressing.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This study utilized an enzyme solubilized calfskin collagen as a dressing for mucosal and gingival wounds in rabbits and dogs. Clinical and histological evaluations carried through the 14 day duration of the experiment showed similar healing between experimental and control sites. The experimental side healed slightly faster and the pigmented tissue was more uniformly regenerated when compared to the controls. The advantages of this wound covering are discussed.		

AD NU.

DDC FILE COPY



DD FORM 1473 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

038 670

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

B

HEALING OF THE ORAL MUCOSA WITH THE
USE OF COLLAGEN ARTIFICIAL SKIN

*MARVIN P. LEVIN, B.S., D.D.S.

**PETER J. TSAKNIS, B.S., D.D.S., M.S.

**DUANE E. CUTRIGHT, M.S., D.D.S., PhD.

*769th Medical Detachment (DS), APO New York 09178

**US Army Institute of Dental Research, Walter Reed Army Medical Center,
Washington, DC 20012

INTRODUCTION

The use of biomaterials to aid in wound healing and in reconstructive surgery has intriguing potential. If a surgeon can take a biologically derived material from a pre-sterilized package and use it as a graft instead of removing tissue from another area on the patient, he can minimize the surgery time and eliminate postoperative problems at the donor side. There would be a benefit to both the patient and the surgeon.

In the past few years several articles have appeared in the literature describing investigations with modified collagen membranes.¹⁻³ Successful results have been described in dialysis and corneal implants.^{4,5} The purpose of the present study is to determine the biocompatibility of collagen artificial skin in the oral mucosa.

MATERIALS AND METHODS

The material used in this investigation is an enzyme-solubilized calfskin collagen originally developed by Nishihara and modified at the Rogosin Laboratories, Cornell University Medical College.⁶ It is packaged individually in sheets 10 x 10 cm and can easily be cut with a scissors to any shape or size desired.

In the first part of the study, 15 New Zealand white rabbits were used. A recipient site was prepared by scalpel blade excision in the muco-buccal vestibule on the maxillae of each animal. A section approximately 2 x 2 cm consisting of epithelium, connective tissue, and underlying subcutaneous fat was removed. (Fig. 1) Periosteum was left intact.

ACCESSION No.	White Section <input type="checkbox"/>	Black Section <input type="checkbox"/>
1 IS	2 IS	3 IS
4 IS	5 IS	6 IS
7 IS	8 IS	9 IS
10 IS	11 IS	12 IS
13 IS	14 IS	15 IS
16 IS	17 IS	18 IS
19 IS	20 IS	21 IS
22 IS	23 IS	24 IS
25 IS	26 IS	27 IS
28 IS	29 IS	30 IS
31 IS	32 IS	33 IS
34 IS	35 IS	36 IS
37 IS	38 IS	39 IS
40 IS	41 IS	42 IS
43 IS	44 IS	45 IS
46 IS	47 IS	48 IS
49 IS	50 IS	51 IS
52 IS	53 IS	54 IS
55 IS	56 IS	57 IS
58 IS	59 IS	60 IS
61 IS	62 IS	63 IS
64 IS	65 IS	66 IS
67 IS	68 IS	69 IS
70 IS	71 IS	72 IS
73 IS	74 IS	75 IS
76 IS	77 IS	78 IS
79 IS	80 IS	81 IS
82 IS	83 IS	84 IS
85 IS	86 IS	87 IS
88 IS	89 IS	90 IS
91 IS	92 IS	93 IS
94 IS	95 IS	96 IS
97 IS	98 IS	99 IS
100 IS	101 IS	102 IS
103 IS	104 IS	105 IS
106 IS	107 IS	108 IS
109 IS	110 IS	111 IS
112 IS	113 IS	114 IS
115 IS	116 IS	117 IS
118 IS	119 IS	120 IS
121 IS	122 IS	123 IS
124 IS	125 IS	126 IS
127 IS	128 IS	129 IS
130 IS	131 IS	132 IS
133 IS	134 IS	135 IS
136 IS	137 IS	138 IS
139 IS	140 IS	141 IS
142 IS	143 IS	144 IS
145 IS	146 IS	147 IS
148 IS	149 IS	150 IS
151 IS	152 IS	153 IS
154 IS	155 IS	156 IS
157 IS	158 IS	159 IS
160 IS	161 IS	162 IS
163 IS	164 IS	165 IS
166 IS	167 IS	168 IS
169 IS	170 IS	171 IS
172 IS	173 IS	174 IS
175 IS	176 IS	177 IS
178 IS	179 IS	180 IS
181 IS	182 IS	183 IS
184 IS	185 IS	186 IS
187 IS	188 IS	189 IS
190 IS	191 IS	192 IS
193 IS	194 IS	195 IS
196 IS	197 IS	198 IS
199 IS	200 IS	201 IS
202 IS	203 IS	204 IS
205 IS	206 IS	207 IS
208 IS	209 IS	210 IS
211 IS	212 IS	213 IS
214 IS	215 IS	216 IS
217 IS	218 IS	219 IS
220 IS	221 IS	222 IS
223 IS	224 IS	225 IS
226 IS	227 IS	228 IS
229 IS	230 IS	231 IS
232 IS	233 IS	234 IS
235 IS	236 IS	237 IS
238 IS	239 IS	240 IS
241 IS	242 IS	243 IS
244 IS	245 IS	246 IS
247 IS	248 IS	249 IS
250 IS	251 IS	252 IS
253 IS	254 IS	255 IS
256 IS	257 IS	258 IS
259 IS	260 IS	261 IS
262 IS	263 IS	264 IS
265 IS	266 IS	267 IS
268 IS	269 IS	270 IS
271 IS	272 IS	273 IS
274 IS	275 IS	276 IS
277 IS	278 IS	279 IS
280 IS	281 IS	282 IS
283 IS	284 IS	285 IS
286 IS	287 IS	288 IS
289 IS	290 IS	291 IS
292 IS	293 IS	294 IS
295 IS	296 IS	297 IS
298 IS	299 IS	300 IS
301 IS	302 IS	303 IS
304 IS	305 IS	306 IS
307 IS	308 IS	309 IS
310 IS	311 IS	312 IS
313 IS	314 IS	315 IS
316 IS	317 IS	318 IS
319 IS	320 IS	321 IS
322 IS	323 IS	324 IS
325 IS	326 IS	327 IS
328 IS	329 IS	330 IS
331 IS	332 IS	333 IS
334 IS	335 IS	336 IS
337 IS	338 IS	339 IS
340 IS	341 IS	342 IS
343 IS	344 IS	345 IS
346 IS	347 IS	348 IS
349 IS	350 IS	351 IS
352 IS	353 IS	354 IS
355 IS	356 IS	357 IS
358 IS	359 IS	360 IS
361 IS	362 IS	363 IS
364 IS	365 IS	366 IS
367 IS	368 IS	369 IS
370 IS	371 IS	372 IS
373 IS	374 IS	375 IS
376 IS	377 IS	378 IS
379 IS	380 IS	381 IS
382 IS	383 IS	384 IS
385 IS	386 IS	387 IS
388 IS	389 IS	390 IS
391 IS	392 IS	393 IS
394 IS	395 IS	396 IS
397 IS	398 IS	399 IS
400 IS	401 IS	402 IS
403 IS	404 IS	405 IS
406 IS	407 IS	408 IS
409 IS	410 IS	411 IS
412 IS	413 IS	414 IS
415 IS	416 IS	417 IS
418 IS	419 IS	420 IS
421 IS	422 IS	423 IS
424 IS	425 IS	426 IS
427 IS	428 IS	429 IS
430 IS	431 IS	432 IS
433 IS	434 IS	435 IS
436 IS	437 IS	438 IS
439 IS	440 IS	441 IS
442 IS	443 IS	444 IS
445 IS	446 IS	447 IS
448 IS	449 IS	450 IS
451 IS	452 IS	453 IS
454 IS	455 IS	456 IS
457 IS	458 IS	459 IS
460 IS	461 IS	462 IS
463 IS	464 IS	465 IS
466 IS	467 IS	468 IS
469 IS	470 IS	471 IS
472 IS	473 IS	474 IS
475 IS	476 IS	477 IS
478 IS	479 IS	480 IS
481 IS	482 IS	483 IS
484 IS	485 IS	486 IS
487 IS	488 IS	489 IS
490 IS	491 IS	492 IS
493 IS	494 IS	495 IS
496 IS	497 IS	498 IS
499 IS	500 IS	501 IS
502 IS	503 IS	504 IS
505 IS	506 IS	507 IS
508 IS	509 IS	510 IS
511 IS	512 IS	513 IS
514 IS	515 IS	516 IS
517 IS	518 IS	519 IS
520 IS	521 IS	522 IS
523 IS	524 IS	525 IS
526 IS	527 IS	528 IS
529 IS	530 IS	531 IS
532 IS	533 IS	534 IS
535 IS	536 IS	537 IS
538 IS	539 IS	540 IS
541 IS	542 IS	543 IS
544 IS	545 IS	546 IS
547 IS	548 IS	549 IS
550 IS	551 IS	552 IS
553 IS	554 IS	555 IS
556 IS	557 IS	558 IS
559 IS	560 IS	561 IS
562 IS	563 IS	564 IS
565 IS	566 IS	567 IS
568 IS	569 IS	570 IS
571 IS	572 IS	573 IS
574 IS	575 IS	576 IS
577 IS	578 IS	579 IS
580 IS	581 IS	582 IS
583 IS	584 IS	585 IS
586 IS	587 IS	588 IS
589 IS	590 IS	591 IS
592 IS	593 IS	594 IS
595 IS	596 IS	597 IS
598 IS	599 IS	600 IS
601 IS	602 IS	603 IS
604 IS	605 IS	606 IS
607 IS	608 IS	609 IS
610 IS	611 IS	612 IS
613 IS	614 IS	615 IS
616 IS	617 IS	618 IS
619 IS	620 IS	621 IS
622 IS	623 IS	624 IS
625 IS	626 IS	627 IS
628 IS	629 IS	630 IS
631 IS	632 IS	633 IS
634 IS	635 IS	636 IS
637 IS	638 IS	639 IS
640 IS	641 IS	642 IS
643 IS	644 IS	645 IS
646 IS	647 IS	648 IS
649 IS	650 IS	651 IS
652 IS	653 IS	654 IS
655 IS	656 IS	657 IS
658 IS	659 IS	660 IS
661 IS	662 IS	663 IS
664 IS	665 IS	666 IS
667 IS	668 IS	669 IS
670 IS	671 IS	672 IS
673 IS	674 IS	675 IS
676 IS	677 IS	678 IS
679 IS	680 IS	681 IS
682 IS	683 IS	684 IS
685 IS	686 IS	687 IS
688 IS	689 IS	690 IS
691 IS	692 IS	693 IS
694 IS	695 IS	696 IS
697 IS	698 IS	699 IS
700 IS	701 IS	702 IS
703 IS	704 IS	705 IS
706 IS	707 IS	708 IS
709 IS	710 IS	711 IS
712 IS	713 IS	714 IS
715 IS	716 IS	717 IS
718 IS	719 IS	720 IS
721 IS	722 IS	723 IS
724 IS	725 IS	726 IS
727 IS	728 IS	729 IS
730 IS	731 IS	732 IS
733 IS	734 IS	735 IS
736 IS	737 IS	738 IS
739 IS	740 IS	741 IS
742 IS	743 IS	744 IS
745 IS	746 IS	747 IS
748 IS	749 IS	750 IS
751 IS	752 IS	753 IS
754 IS	755 IS	756 IS
757 IS	758 IS	759 IS
760 IS	761 IS	762 IS
763 IS	764 IS	765 IS
766 IS	767 IS	768 IS
769 IS	770 IS	771 IS
772 IS	773 IS	774 IS
775 IS	776 IS	777 IS
778 IS	779 IS	780 IS
781 IS	782 IS	783 IS
784 IS	785 IS	786 IS
787 IS	788 IS	789 IS
790 IS	791 IS	792 IS
793 IS	794 IS	795 IS
796 IS	797 IS	798 IS
799 IS	800 IS	801 IS
802 IS	803 IS	804 IS
805 IS	806 IS	807 IS
808 IS	809 IS	810 IS
811 IS	812 IS	813 IS
814 IS	815 IS	816 IS
817 IS	818 IS	819 IS
820 IS	821 IS	822 IS
823 IS	824 IS	825 IS
826 IS	827 IS	828 IS
829 IS	830 IS	831 IS
832 IS	833 IS	834 IS
835 IS	836 IS	837 IS
838 IS	839 IS	840 IS
841 IS	842 IS	843 IS
844 IS	845 IS	846 IS
847 IS	848 IS	849 IS
850 IS	851 IS	852 IS
853 IS	854 IS	855 IS
856 IS	857 IS	858 IS
859 IS	860 IS	861 IS
862 IS	863 IS	864 IS
865 IS	866 IS	867 IS
868 IS	869 IS	870 IS
871 IS	872 IS	873 IS
874 IS	875 IS	876 IS
877 IS	878 IS	879 IS
880 IS	881 IS	882 IS
883 IS	884 IS	885 IS
886 IS	887 IS	888 IS
889 IS	890 IS	891 IS
892 IS	893 IS	894 IS
895 IS	896 IS	897 IS
898 IS	899 IS	900 IS
901 IS	902 IS	903 IS
904 IS	905 IS	906 IS
907 IS	908 IS	909 IS
910 IS	911 IS	912 IS
913 IS	914 IS	915 IS
916 IS	917 IS	918 IS
919 IS	920 IS	921 IS
922 IS	923 IS	924 IS
925 IS	926 IS	927 IS
928 IS	929 IS	930 IS
931 IS	932 IS	933 IS
934 IS	935 IS	936 IS
937 IS	938 IS	939 IS
940 IS	941 IS	942 IS
943 IS	944 IS	945 IS
946 IS	947 IS	948 IS
949 IS	950 IS	951 IS
952 IS	953 IS	954 IS
955 IS	956 IS	957 IS
958 IS	959 IS	960 IS
961 IS	962 IS	963 IS
964 IS	965 IS	966 IS
967 IS	968 IS	969 IS
970 IS	971 IS	972 IS
973 IS	974 IS	975 IS
976 IS	977 IS	978 IS
979 IS	980 IS	981 IS
982 IS	983 IS	984 IS
985 IS	986 IS	987 IS
988 IS	989 IS	990 IS
991 IS	992 IS	993 IS
994 IS	995 IS	996 IS
997 IS	998 IS	999 IS
1000 IS	1001 IS	1002 IS
1003 IS	1004 IS	1005 IS
1006 IS	1007 IS	1008 IS
1009 IS	1010 IS	1011 IS
1012 IS	1013 IS	1014 IS
1015 IS	1016 IS	1017 IS
1018 IS	1019 IS	1020 IS
1021 IS	1022 IS	1023 IS
1024 IS	1025 IS	1026 IS
1027 IS	1028 IS	1029 IS
1030 IS	1031 IS	1032 IS
1033 IS	1034 IS	1035 IS
1036 IS	1037 IS	1038 IS
1039 IS	1040 IS	1041 IS
1042 IS	1043 IS	1044 IS
1045 IS	1046 IS	1047 IS
1048 IS	1049 IS	1050 IS
1051 IS	1052 IS	1053 IS
1054 IS	1055 IS	1056 IS
1057 IS	1058 IS	1059 IS
1060 IS	1061 IS	1062 IS
1063 IS	1064 IS	1065 IS
1066 IS	1067 IS	1068 IS
1069 IS	1070 IS	1071 IS
1072 IS	1073 IS	1074 IS
1075 IS	1076 IS	1077 IS
1078 IS	1079 IS	1080 IS
1081 IS	1082 IS	1083 IS
1084 IS	1085 IS	1086 IS
1087 IS	1088 IS	1089 IS
1090 IS	1091 IS	1092 IS
1093 IS	1094 IS	1095 IS
1096 IS	1097 IS	1098 IS
1099 IS	1100 IS	1101 IS
1102 IS	1103 IS	1104 IS
1105 IS	1106 IS	1107 IS
1108 IS	1109 IS	1110 IS
1111 IS	1112 IS	1113 IS
1114 IS	1115 IS	1116 IS
1117 IS	1118 IS	1119 IS
1120 IS	1121 IS	1122 IS
1123 IS	1124 IS	1125 IS
1126 IS	1127 IS	1128 IS
1129 IS	1130 IS	1131 IS
1132 IS	1133 IS	1134 IS
1135 IS	1136 IS	1137 IS
1138 IS</		

A piece of Nippi Collagen Artificial Skin*, which was previously sterilized with ethylene oxide, was cut to size and sutured over the prepared wound. (Figure 2) An identical wound was made contralaterally, but no covering was placed; this served as a control.

The rabbits were sacrificed according to a time schedule that rendered three surgical sites and three controls for 3, 5, 10, 14, and 21 days. Specimens were harvested, fixed in 10% buffered formalin, imbedded in paraffin, and stained with hematoxylin and eosin.

As a second part of the study, surgical procedures were performed in 5 dogs on the facial maxillary and mandibular attached gingivae and alveolar mucosae of all four canine teeth. The wounds resembled recipient sites for free tissue autografts. (Figure 3) Collagen was sutured over the left maxillary and mandibular wound areas. (Figure 4) The right side served as the control. Gross and histological evaluations were made on 5, 7, and 14 day specimens.

RESULTS

The rabbit findings showed that experimental and control sites were almost identical. Observation of the surgical site at 3 and 5 days after surgery revealed a wound covered by a white opaque coagulum of soft tissue. Attempts at removing the granulation tissue plug indicated the wound was well organized and firmly established to the underlying and surrounding mucosa. The mucosal periphery assumed a normal light pink color and there was no evidence of edema in the area.

* Japan Leather Company, Ltd., Tokyo, Japan

Microscopically the specimens displayed all the elements of normally healing mucosal granulation tissue. Proliferating blood vessels were universal throughout the wounds. The predominant cellular component consisted of polymorphonuclear leukocytes, which were particularly heavy at the superficial aspects of the wound. Lymphocytes and plasma cells were noted but were much fewer in number, and eosinophils and foreign body giant cells were not seen. Epithelial resurfacing was actively advancing and extended below the upper necrotic portion of the wound but above the underlying proliferating and organizing granulation tissue. (Figure 5a)

Succeeding time periods of 10, 14, and 21 days demonstrated a subsequent reduction of the inflammatory cells and of the vascularity. A continuous contraction of the wound occurred with formation of mature fibrous connective tissue, eventual total re-epithelialization and complete unremarkable healing. (Figure 5b) At the final sacrifice period of 21 days, the original wound site was indiscernible. The results, therefore, indicated that the collagen graft did not cause any adverse reaction to wound healing in the oral mucosae of rabbits.

In dogs the artificial skin was seen to readily adhere to the wound sites and acted as a hemostatic agent. (Figure 4) At 5 days postoperatively adhering, organizing granulation tissue similarly covered the entire surgical wound in both experimental and control animals. Edema, although present, was not pronounced.

By the 7th day inflammation was diminishing but was still present. Clinically, healing was slightly more advanced in the experimental animals

and there was evidence of some pigmentation on the epithelial surface. (Figures 6a, 6b, and 6c) The 14-day postoperative sites showed the final stages of epithelialization. (Figures 7a, 7b, and 7c) There was no indication of abnormal mitosis, nuclear pleomorphism, or dysplastic changes in either the control or experimental specimens.

DISCUSSION

Within the parameters of this study, results indicate the modified collagen graft does not effect an adverse reaction in any of the animals, rabbit or dog, when placed as a wound covering. The dog gingivae did heal slightly more rapidly on the experimental side. The authors are aware that many variables exist in an investigation such as this, and conclusions must be tempered. There is no indication of what would occur if the material were to be placed over an oral wound in a human. Studies have already shown that, when the collagen is treated by ultraviolet radiation, immunologic reactivity is lost.^{3,7} Thus, antigenicity may not be a problem and was not detected in this study.

In the present investigation there is no means of determining if the collagen membrane actually entered into the healing process, contributing its triple helix structure as a latticework for regenerating tissue. Or does it function strictly as a biologic dressing? In either case the collagen dressing certainly does not appear to delay healing. The advantages of collagen membranes are comparable to those ascribed to freeze-dried skin grafts,⁸ namely:

1. Protection of the surgical wound from irritation and trauma.

2. Elimination of a donor site markedly reduces patient morbidity.
3. Abundant availability of graft material does not impose dimensional limitations to the surgical site.

The utilization of collagen membranes in oral surgery and periodontics offers various potential ideas. Additional research is much needed in this area.

SUMMARY

Wounds were prepared in the oral cavity of 15 rabbits and 5 dogs, and an enzyme-solubilized calfskin collagen was placed over the surgery sites on one side. The contralateral sides acted as controls. Results indicated the membrane is biologically acceptable to the oral mucosae of rabbits and dogs. The collagen did not cause any adverse reactions and may have been responsible for the clinical opinion of slightly more rapid healing of the gingivae in dogs. Clinical implications of this material's utilization produce some exciting ideas for future research.

This paper was presented in part at the 55th general meeting of the International Association for Dental Research, April 1977, Copenhagen.

REFERENCES

1. Cucin, R.L., Goulian, D. Jr., Stenzel, K.H. and Rubin, A.L.: The Effect of Reconstituted Collagen Gels on the Healing of Experimental Bony Defects: A Preliminary Report. J. Surg. Res., 12:318, 1972.
2. Vistnes, L.M., Goodwin, D.A., Tenery, J.H., Ksander, G.A., and Gruber, R.P.: Control of Capillary Bleeding by Topical Application of Microcrystalline Collagen. Surgery, 76:291, 1974.
3. Tavis, M.J., Harney, J.H., Thornton, J.W., and Bartlett, R.H.: Modified Collagen Membrane as a Skin Substitute: Preliminary Studies. J. Biomed. Mater. Res., 9:285, 1975.
4. Rubin, A.L. and Stenzel, K.H.: Collagen as a Biomaterial. Technology Review, 71:3, 1968.
5. Dunn, M.W., Nishihara, T., Stenzel, K.H., Branwood, A.W., and Rubin, A.L.: Collagen Derived Membrane: Corneal Transplantation. Science, 157:1329, 1967.
6. Nishihara, T., Rubin, A.L., and Stenzel, K.H.: Biologically Derived Collagen Membranes. Trans. Amer. Soc. Artif. Int. Organs, 10:243, 1967.
7. Miyata, T., Sohde, T., Rubin, A.L., and Stenzel, K.H.: Effects of Ultraviolet Irradiation on Native and Telopeptide-Poor Collagen. Biochim. Biophys. Acta, 229:672, 1971.
8. Yukna, R.A., Tow, H.D., Carroll, P.B., Vernino, A.R., Bright, R.W.: Comparative Clinical Evaluation of Freeze-Dried Skin Allografts and Autogenous Gingival Grafts in Humans. J. Clin. Periodontol., 4:191, 1977.

LEGENDS

- Figure 1. Surgical site in muco-buccal vestibule of rabbit.
- Figure 2. Collagen membrane sutured to prepared surgical site.
- Note hemostatic effect of the membrane.
- Figure 3. Surgical site prepared on maxillary left facial aspect of dog canine.
- Figure 4. Collagen membrane sutured over surgical area. Note hemostasis.
- Figure 5a. 5-day rabbit, experimental side. Actively regenerating stratified squamous epithelium displaces necrotizing granulated plug (64X).
- Figure 6a. 7-day post op, dog, experimental side. Note beginning of pigmentation (arrow).
- Figure 6b. 7-day post-op, dog, control side.
- Figure 6c. 7-day dog, experimental side. Peripheral migration of proliferating epithelium across the surgical wound is apparent. Note paucity of inflammatory cells and pronounced vascularity (64X).
- Figure 7a. 14-day post-op, dog, experimental side. There is good healing from the surgery, but a marginal gingivitis is present.
- Figure 7b. 14-day post-op, dog, control side. There is good healing but a marginal gingivitis is present. Pigmentation is not complete.
- Figure 7c. 14-day dog, experimental side. Resurfacing by parakeratinized stratified squamous epithelium is complete (64X).

ACKNOWLEDGEMENTS:

The authors are grateful for the technical assistance provided by Mr. Eugene Peguese and Ms. Janet Pierce.

FIGURE 1



FIGURE 2



FIGURE 3



FIGURE 4



FIGURE 5a



FIGURE 6a



FIGURE 6b



FIGURE 7a



FIGURE 7b



FIGURE 7c

